File Number: 25-13

Joint
Computer-aided Acquisition
and Logistic Support (JCALS)
CALS Technology Center (CTC)

Requirements Paper

Recognition Of Image Drawing Title For Population In Permanent Storage

CONTRACT NO.: DAAB07-93-D-T001
TASK NO.: 96-23

15 November 1996

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PM JCALS

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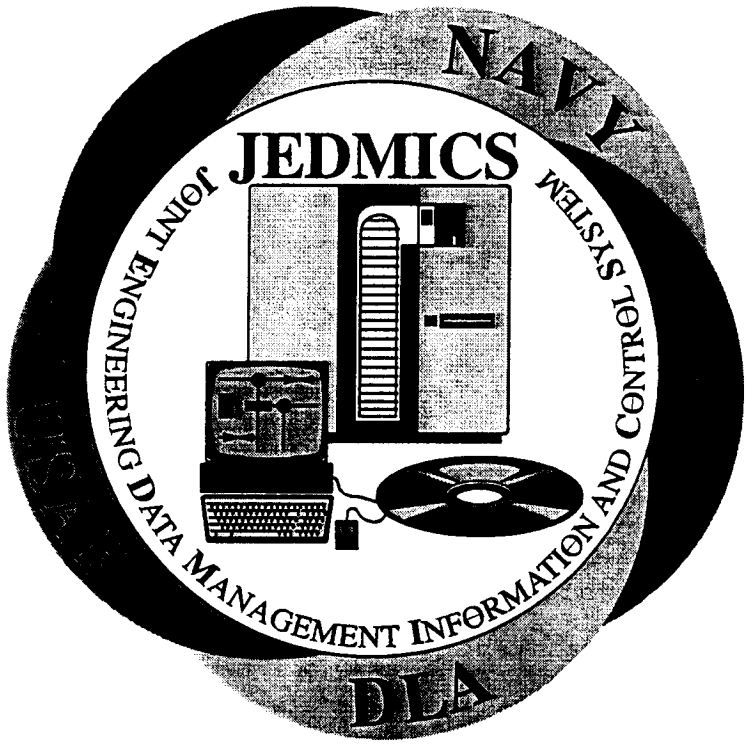
Joint Engineering Data Management Information And Control System/ Computer-Assisted Data Acceptance (JEDMICS/CADA)

Requirments Paper

Recognition Of Image Drawing Title For Population In Permanent Storage



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RECOGNITION OF IMAGE DRAWING TITLE FOR POPULATION IN PERMANENT STORAGE

1. INTRODUCTION

With the advances in image processing and pattern recognition technologies, the ability to extract inherent information from raster images is becoming more plausible. As part of the Computer-Assisted Data Acceptance/Joint Engineering Data Management Information Control Systems (CADA/JEDMICS) effort, the index information contained in JEDMICS can be verified against the data strings found in the title blocks of engineering drawings as well as the top (and/or bottom) portions of associated lists.

In hoping to verify and extract as much information as possible, it has been suggested that the drawing title be extracted from the raster image. Currently this information is not populated in Pending or Permanent, although the data base schema has a field for the drawing title. This paper will discuss the steps involved with in capturing, and will address its feasibility, provided the task goes forward, as well as provide the findings of a preliminary investigation.

2. DRAWING TITLE EXTRACTION

When CADA processes the title block, information occurs within the ID[1] module. Currently, this module has the following responsibilities:

- location of index information within the image,
- segmentation of the identified index strings,
- submission of the strings for recognition,
- performing post-processing on the recognition results, and
- verification of the final text results.
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[1] CADA has five modules: image, UI (user interface), ID, input (which includes 1840 and JEDMICS interface), and output.

2.1 Location

For the location of the drawing title, it is assumed that this title will exist in one of two places within the image. These categories are:

- the engineering drawing category: directly on top of the engineering drawing title block (see figure 2.1.1), or
- the lists category: within the identification information (top) of lists (see figure 2.1.2).

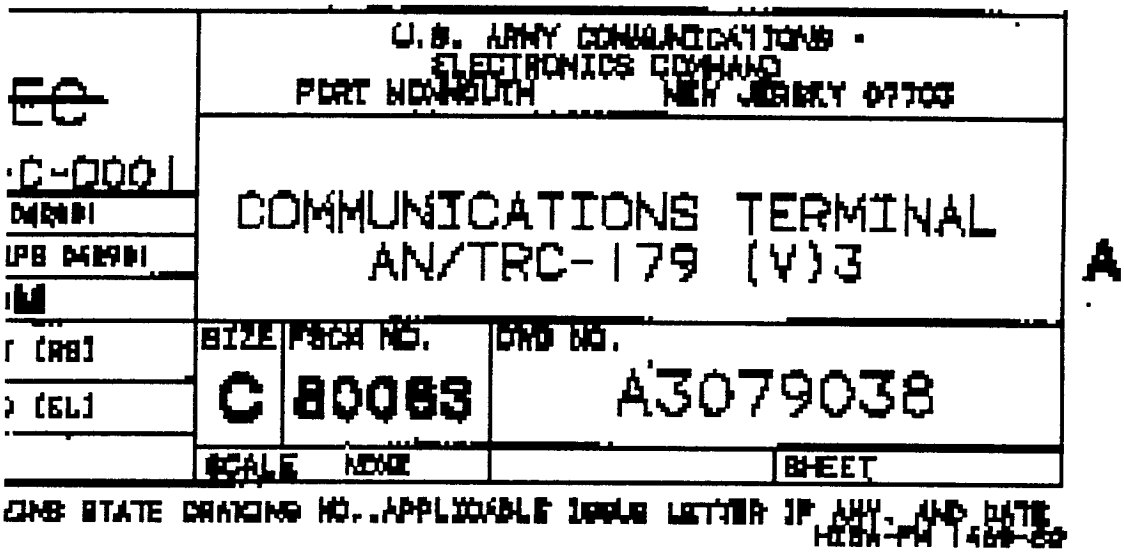
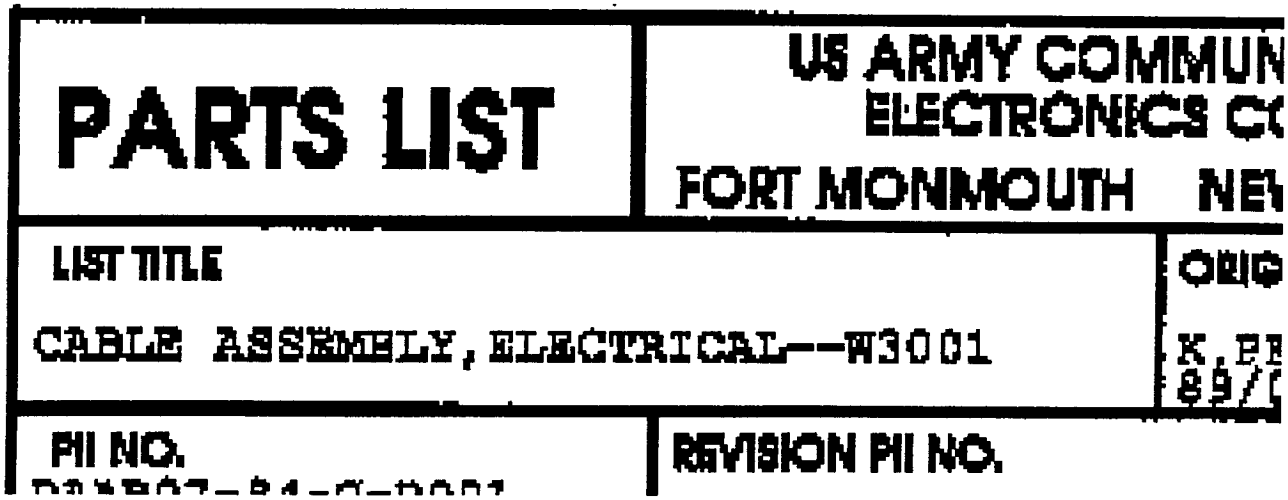


Figure 2.1.1. Location of drawing title in an engineering drawing image



Figures 2.1.2. Location of drawing title in a lists image.

CADA would perform a classification of an image before ID processing. It will determine if the image falls into the engineering drawing category or the lists category. Given the expected location of the drawing title within an engineering drawing, CADA will be able to expand its current segmentation area to determine if the title exists. If the title does exist, it will extract the appropriate strings.

For a lists image, CADA will need to rely heavily on the presence of a label string. The specific possibilities for drawing title labels will need to be known to CADA beforehand. Examples are: *title*, *list title*, and *drawing title*.

2.2 Recognition

After segmentation is performed, the strings will be submitted to the neural network engine[2] for recognition. Currently for script recognition, one can assume a 70 percent correct word recognition provided the input image is of good quality[3]. For CADA index verification, correct recognition is measured in terms of characters, not words. For drawing titles this measurement can be relaxed to the word level. Also, it is almost impossible to ensure correct word recognition due to the absence of any strings to compare against the recognition results.

After recognition, CADA performs extensive *cleanup* or post-processing on the recognition results. This is to ensure that the strings have been split correctly during segmentation, and that the recognition results are somewhat legitimate candidate strings for index comparisons. In the case of the drawing title, cleanup will need to be less ambitious.

During this cleanup, CADA performs character folding on all characters within the label dictionary, the recognition results, and the index information. This is because there is no way for the recognition engine to be expected to correctly distinguish between such characters as a 1 and an I, or a 0 and a O. Since all strings are folded, meaning they are mapped to a common character for specific character groups, the misinterpretation of the characters by the recognition engine is not a factor. Therefore, the folding classes currently used within CADA will need to be used more aggressively.

2.3 Submission

The product release of CADA, scheduled for October 1996 will include the ability to write a new batch to the pending data base. This submission will be expanded to include the insertion of the drawing title into the JMX_drawingTitle parameter[4].

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2 NestorReader 3.0 is currently in use within CADA. Additionally, CADA has a trained memory in place which was the result of training on hand-print strings from engineering drawing title blocks.

3 Bradford, Roger, "*Current Developments in OCR,*" The AIIM Show & Conference Proceedings, April 2, 1996, pp 156-164.

4 This is currently a JEDMICS API version 2.5 Attribute ID.

3. PRELIMINARY FINDINGS

3.1 Test Data

For this preliminary test, a test set was generated using a variety of engineering drawing image qualities. Although this set is not extensive, it does provide both good quality and bad quality text within the drawing titles. The set is composed of 26 images gathered from the CECOM[5] JEDMICS site.

3.2 Test Procedures

For this testing, the drawing titles were manually segmented from the engineering drawing and saved as separate Tagged Image File Format (TIFF) files. This manual segmentation was performed for two reasons:

- string segmentation is currently being successfully used within CADA, and
- specific title string location has not been discussed and is currently only assumed to be found in the locations cited in section 2.1.

The purpose of this test was to investigate the raw recognition of the drawing title.

The individual TIFF files were processed using NestorReader 3.0 and the CADA trained memory.

The recognized results were extracted from the Nestor generated zone recognition file (.zrf).

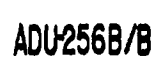
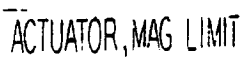
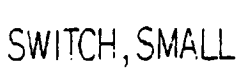
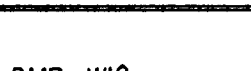
As part of this process, some cleanup was performed. This cleanup focused on line-thinning and line-fattening and was extracted from the current algorithms used within CADA.

3.3 Results

The following table shows the results of this investigation. The column titled *'TIFF image'* contains the contents of the segmented drawing titles. The column titled *'Recognition Results'* contains the results after recognition.

[5] This site is located at Ft. Monmouth, NJ.

Table 1. Drawing Title Recognition Results.

FILE	TIFF image	Recognition Results
1		ADAPTER BOMB CLUSTER
2		ADUH256B/B
3		ACTUATOR MAG LLMLT
4		SWI TCP$SN1ALL
5		ADAPTER BOMB CLUSTER
6		CABLE ASSEMBLY
7		DMP-WI2
8		CHART RADIOGRAPHIC
9		POS1TTION
10		FOR BRACKET L 2282029
11		CLA
12		DUPLEX BEARING ASSY

FILE	TIFF image	Recognition Results
13	GEARSHAFT ASSEMBLY-	GEARSHAFT ASSEMBLYE
14	INSTALLATION CONTROL DRAWING	)*$1A44I- ON CONIED(OF 4V) N(
15	NUT, PLAIN-BARREL	NUT PLALN-BARREL
16	PLUG, GROMMET	PL
17	REGULATOR	REGJLATOR
18	SCAN POSITION SENSOR	SCAN RBNON SNQY
19	CABLE ASSEMBLY.	CABLE ASSEMBLY
20	SPECIAL PURPOSE	SPECTAL PURPOSE
21	ELECTRICAL	ELECTRLCAL
22	STRAP, CABLE	STRAP*CASLE
23	IDENTIFICATION	DENLFI CATW
24	ADJUSTABLE, PLASTIC	ADUSTABLE PLAS-C
25		SUPPORT LSOLATOR

FILE	TIFF image	Recognition Results
	SUPPORT, ISOLATOR	
26	SUPPORT- TE, WING	5UPPDRN- RF) Z//G

These strings were passed through minor character cleanup routines: specifically for line thinning and fattening. No attempt was made at character folding.

As can be seen, given the diversity of the quality, font size, and font types an exact word recognition is not always possible.

The results were as follows.

Total Words:	55
Words Correct:	27
Percent Word Correct	***49%***
Total Characters	364
Characters Correct	267
Percent Characters Correct	***73%***

4. CONCLUSION/RECOMMENDATIONS

The following are the conclusions of this preliminary investigation.

- The word recognition result of 49% shows that using folding class characters may provide some improvement.
- The quality of the recognition result, even with limited correction, depends heavily on the quality of the input image.
- Even with the CADA trained memory, differences in hand print may yield unusable results.
- Due to the recognition engines, inability to distinguish between certain class characters, a folding mechanism will have to be introduced in order to yield correct search results using the drawing title.

The following are the recommendations of this preliminary investigation, should the need exist to go further with this task.

- A complete list of possible areas where a drawing title may exist within an engineering drawing, associated list, or accompanying document should be generated.
- A complete list of possible drawing title label strings should be generated.
- An investigation of the means for providing for *'fuzzy searching'* of the drawing title within JEDMICS should be conducted.